



TRACIE

HEALTHCARE EMERGENCY PREPAREDNESS
INFORMATION GATEWAY

Natural Disasters
Topic Collection
11/6/2015

Topic Collection: Natural Disasters

Natural disasters and their consequences (e.g., flooding, injuries experienced during clean up) can wreak havoc on healthcare facilities and the communities they serve. It is important for emergency planners to enroll in alert systems, monitor weather forecasts and have a solid natural disaster or all hazards facility response plan that complements their jurisdiction's plan. The resources in this Topic Collection highlight lessons learned from recent events, communication tools and information, and checklists, plans, tools, and templates that can be modified to suit specific threats and needs. Articles in this Topic Collection address specific natural disasters and hazards and elements of their planning, but do not address all-hazard planning or specifics of clinical care which may be found in other topic collections.

Each resource in this Topic Collection is placed into one or more of the following categories (click on the category name to be taken directly to that set of resources). Resources marked with an asterisk (*) appear in more than one category.

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Must Reads

American Meteorological Society. (2014). [A Prescription for the 21st Century: Improving Resilience to High-Impact Weather for Healthcare Facilities and Services](#).

This report shares workshop findings on increasing and improving the resilience of healthcare facilities and services to high-impact weather events. The workshop grouped their findings into three main categories: hardening structures, making incremental adaptations, and implementing innovative practices.

Arnold, C., Holmes, W., Quinn, R., et al. (2007). [Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds](#). Federal Emergency Management Agency.

This design guide can inform and help design professionals, hospital administrators, and facility managers employ sound mitigation measures that will decrease the vulnerability of hospitals to disruptions from natural hazard events (e.g., earthquakes, high wind events, floods).

Bernard, S. and McGeehin, M.A. (2004). [Municipal Heat Wave Response Plans](#). American Journal of Public Health. 94(9):1520.

The authors review heat wave plans from 18 cities and list recommendations for overcoming challenges (e.g., targeted outreach geared towards the socially isolated, begin prevention efforts before high temperatures arrive, and collect and use data to determine the effectiveness of interventions).

Centers for Disease Control and Prevention. (2011). [Extreme Heat and Your Health: Media Toolkit](#).

The materials on this webpage include a toolkit, web tools, and press release and other templates that can help community leaders develop communication plans for extreme heat events.

Children's Hospital and Research Center Oakland. (n.d.) [Children's Hospital Earthquake Response Guide](#). (Accessed 10/20/2015.)

The goal of this plan is to maintain hospital operations for at least four days after a major earthquake and to ensure that care continues for patients, visitors, and survivors of the earthquake. This plan can be adapted to meet the needs of hospital emergency response professionals and healthcare preparedness planners.

City of New York, Department of Health and Mental Hygiene. (2013). [Heat Wave Preparedness Checklists for Vulnerable Population Service Providers](#).

These checklists can help healthcare and other service providers identify vulnerable residents at highest risk for heat-related illnesses.

Committee on Public Response to Alerts and Warnings on Mobile Devices, National Research Council. (2011). [Public Response to Alerts and Warnings on Mobile Devices: Summary of a Workshop on Current Knowledge and Research Gaps](#). (Users need to register to download this free PDF.)

This book is a summary of a conference where risk communications experts discussed the public response to mobile alerts.

Novation. (n.d.) [Emergency Disaster Plan Template](#). (Accessed 10/20/2015.)

Healthcare facility emergency planners can use this template when developing their emergency operations plan. It features 12 disaster scenarios, including: hurricane, tornadoes, structure fires, earthquakes, and extreme cold.

Reynolds, M. (n.d.). [The Joplin Tornado: The Hospital Story and Lessons Learned](#). (Accessed 10/20/2015.) Leading Edge Missouri.

The presenter focuses on four main areas: the impact of an unexpected natural disaster on healthcare services; how the nation responded to help the Joplin community; how to incorporate lessons learned into planning; and how to design enhancements that can protect against future incidents.

Schultz, C. (2014). [The Hospital Response after an Earthquake](#).

The speaker presents an in-depth overview of the hospital response to earthquakes that struck California in 1971 and 1994. He divided his findings by functional and non-functional hospitals, and presented information on communication challenges, staff behavior (e.g., decisions to report to work), and potential sources of assistance should a similar earthquake strike the Jerusalem area of Israel.

Shroades, R. (2007). [Flood Preparedness: Once Bitten, Twice Ready](#). Facility Maintenance Decisions.

This article documents how facility staff from Memorial Hermann Hospital incorporated lessons learned after Tropical Storm Allison flooded the facility with almost 40 feet of water in 2001.

Sugerman, D. and Armstrong, J. (2013). [Prevention and Treatment of Injuries Following Hurricanes and Tornadoes](#). Centers for Disease Control and Prevention.

This one-hour webinar covers the provision of pre-hospital care; the patterns of injury seen after hurricanes and tornadoes, including appropriate initial management; appropriate emergency risk communication messages; and the importance of data collection to improve messaging and response efforts.

The Lancet. (2015). [Health Professionals: Be Prepared for Heatwaves](#). 386(9990): 219.

This editorial provides an overview of factors and issues to consider during heatwaves. The article includes links to the report authored by the World Health Organization and World Meteorological Organization, guidance from the Centers for Disease Control and Prevention, and other applicable webpages.

The National Academies Press. (2013). [Public Response to Alerts and Warnings Using Social Media: Report of a Workshop on Current Knowledge and Research Gaps](#).

This report summarizes presentations made at a 2012 workshop organized by the Committee on Public Response to Alerts and Warnings Using Social Media. Chapters cover the fundamentals of alerts, warnings, and social media, how social media is used in emergencies, the dynamics of social media, message credibility, privacy and legal issues, and research gaps and other challenges.

U.S. Department of Health and Human Services (HHS). (2014). [Primary Protection: Enhancing Health Care Resilience for a Changing Climate](#).

This 86-page document is a guide and toolkit designed to assist healthcare providers, design professionals, policymakers, and others with roles and responsibilities in assuring the continuity of quality health and human care before, during, and after extreme weather events. It is focused on healthcare infrastructure resilience to climate change impacts as manifested primarily by extreme weather events.

U.S. Environmental Protection Agency, Office of Atmospheric Programs. (2006). [Excessive Heat Events Guidebook](#).

This guidebook identifies best practices that have been implemented to save lives during excessive heat events in various urban areas. It provides critical information needed to help local public health officials, emergency managers, meteorologists, and others assess their community's vulnerability to excessive heat waves, and develop and implement notification and response programs.

Alerts, Warnings, and Communications

Bennet, K. Olsen, J., Harris, S., et al. (2013). [The Perfect Storm of Information: Combining Traditional and Non-Traditional Data Sources for Public Health Situational Awareness During Hurricane Response](#).

This study investigated whether non-traditional data (e.g., tweets and news reports) fill a void in traditional data reporting during hurricane response, as well as whether non-traditional data improve the timeliness for reporting identified HHS Essential Elements of Information (EEI).

Burger, J., Gochfeld, M., Jeitner, C., et al. (2013). [Trusted Information Sources Used During and After Superstorm Sandy: TV and Radio Were Used More Often Than Social Media.](#) Journal of Toxicology and Environmental Health. 76(20):1138-50.

The authors examined information sources used for Superstorm Sandy with respect to the storm, evacuation routes, shelters, safety, and health issues in Central New Jersey and Jersey Shore communities. They conclude that the reliance on traditional sources of information (i.e., TV, radio, friends) observed suggests that the extreme power outages made web, cell phones, and social media on cell phones less usable.

*Centers for Disease Control and Prevention. (2011). [Extreme Heat and Your Health: Media Toolkit.](#)

The materials on this webpage include a toolkit, web tools, and press release and other templates that can help community leaders develop communication plans for extreme heat events.

Committee on Public Response to Alerts and Warnings on Mobile Devices, National Research Council. (2011). [Public Response to Alerts and Warnings on Mobile Devices: Summary of a Workshop on Current Knowledge and Research Gaps.](#) (Free registration required for download.)

This book is a summary of a conference where risk communications experts discussed the public response to mobile alerts.

Enotem, Inc. (2015). [The Emergency Email and Wireless Network.](#)

Users can register to subscribe to local weather, health, homeland security and cybercrime alerts delivered by email and/or text message.

Genes, N., Chary, M., and Chason, K. (2014). [Analysis of Twitter Users' Sharing of Official New York Storm Response Messages.](#) Medicine 2.0. 3(1):e1.

The authors evaluated official New York City tweets related to Superstorm Sandy (2012) and winter storm Nemo (2013) and how often they were re-tweeted. They found that information was shared beyond existing follower bases; official tweets during Sandy had lower lexical diversity, with links to more information, and were retweeted more than unofficial Sandy tweets; and NEMO-related tweets containing more general information were retweeted more often than those containing actionable information.

Harris Smith, S., Bennett, K.J., and Livinski, A.A. (2014). [Evolution of a Search: The Use of Dynamic Twitter Searches During Superstorm Sandy.](#) PLoS Currents. 6: ecurrents.dis.de9415573fbf90ee2c585cd0b2314547.

The authors describe how they used Twitter for situational awareness during Superstorm Sandy in 2012.

National Weather Service. (n.d.) [Email and SMS Weather Alert Services](#). (Accessed 10/20/2015.)

The National Weather Service provides links to federal and external alert and warning sources

National Weather Service. (2011). [Sources of Tsunamis Information](#).

The National Weather Service provides links to sources that provide tsunami event messages.

*National Wildfire Coordinating Group. (2015). [InciWeb](#).

This webpage provides up-to-date information on wildfires across the country. Users can search by state or incident name. Photographs, announcements, and news articles are also included.

The National Academies Press. (2013). [Public Response to Alerts and Warnings Using Social Media: Report of a Workshop on Current Knowledge and Research Gaps](#).

This report summarizes presentations made at a 2012 workshop organized by the Committee on Public Response to Alerts and Warnings Using Social Media. Chapters cover the fundamentals of alerts, warnings, and social media, how social media is used in emergencies, the dynamics of social media, message credibility, privacy and legal issues, and research gaps and other challenges.

*U.S. Department of Health and Human Services. (2015). [GeoHealth Platform](#).

This tool provides central access to federal disaster and public health related natural disaster alerts, warnings, and other resources.

U.S. Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response. (2015). [HHS emPOWER Map](#).

Healthcare providers, electric company representatives, and community members can use this map to find the monthly total of Medicare beneficiaries with electricity-dependent equipment claims at the U.S. state, territory, county, and zip code level and enable “real-time” NOAA severe weather tracking services to identify areas and populations that may be at risk of/impacted by power outages.

U.S. Geological Survey. (2014). [Earthquake Notification Service](#). U.S. Department of the Interior.

The U.S. Geological Survey provides this free service that notifies users when earthquakes occur in their area.

World Meteorological Organization and World Health Organization. (2015.) [Heatwaves and Health: Guidance on Warning-System Development](#).

These guidelines provide an overview of general heat–health problem and describe how an understanding of the biometeorology, epidemiology, public-health and risk-communication aspects of heat as a hazard can be used to inform the development of a heat-health warning system (HHWS) as part of a wider heat-health action plan (HHAP).

At-Risk Populations

(Note: This is a sampling of resources specific to natural hazards. ASPR TRACIE has developed a comprehensive Topic Collection on [Access and Functional Needs](#) and is in the process of developing collections on [Pediatric Issues](#) and [Mental/Behavioral Health](#).)

California Office of Statewide Health & Planning Development. (2015). [Skilled Nursing Facilities](#).

The guidelines included on this webpage can help healthcare facility staff ensure they are in compliance with earthquake-related codes.

*City of New York, Department of Health and Mental Hygiene. (2013). [Heat Wave Preparedness Checklists for Mental Health Service Providers](#).

These checklists can help mental health service providers identify consumers and vulnerable residents at highest risk for heat-related illnesses.

*City of New York, Department of Health and Mental Hygiene. (2013). [Heat Wave Preparedness Checklists for Vulnerable Population Service Providers](#).

These checklists can help healthcare and other service providers identify vulnerable residents at highest risk for heat-related illnesses.

National Health Care for the Homeless Council. (2013). [Surviving Severe Weather: Tools to Promote Emergency Preparedness for People Experiencing Homelessness](#).

To facilitate discussions about emergency preparedness, the National Health Care for the Homeless Council has developed a series of weather-specific informational flyers specifically for people who lack housing. These resources were created with input from people who are formerly and currently homeless and may be of interest to public health educators, emergency management officials, homeless service providers, and homeless community leaders.

Education and Training

American Geosciences Institute. (2015). [Communicating Cascadia's Earthquake Risk](#).

The speakers in this webinar discuss the earthquake risk in the Cascadia subduction zone in the Pacific Northwest. Challenges for planners and communication and mitigation strategies are also discussed.

Federal Emergency Management Agency, Emergency Management Institute. [IS-271.A: Anticipating Hazardous Weather & Community Risk, 2nd Edition.](#)

This 9-hour course covers: weather basics and forecasting; threats analysis and hazards planning; fact sheets for weather and non-weather-related hazards; warning partnership information; and human behavior and community response.

Federal Emergency Management Agency, Emergency Management Institute. [IS-324.A: Community Hurricane Preparedness.](#)

This 10-hour course is targeted to those involved in the decision making process for hurricanes and includes basic information about: how hurricanes form and the hazards they pose; how the National Weather Service (NWS) forecasts future hurricane behavior; and what tools and guiding principles can help emergency managers prepare their communities.

Federal Emergency Management Agency, Emergency Management Institute. [IS-325: Earthquake Basics: Science, Risk, and Mitigation.](#)

This 30-minute course presents basic information on earthquake science, risk, and mitigation. It also discusses techniques for structural and non-structural earthquake mitigation.

Federal Emergency Management Agency, Emergency Management Institute. [IS-326: Community Tsunami Preparedness.](#)

This 6-hour course helps emergency managers prepare their communities for tsunamis. It covers basic tsunami science, hazards produced by tsunamis, regional U.S. tsunami risks, the tsunami warning system, the importance of public education activities, and how to craft good emergency messages and develop tsunami response plans.

General Hazard Mitigation and Utilities Failure

*Banatin, C. and Go, M. (2010). [Safe Hospitals in Emergencies and Disasters: Structural, Non-Structural and Functional Indicators.](#) World Health Organization, Regional Office for the Western Pacific.

This vulnerability assessment highlights structural, non-structural, and functional elements that must be considered to ensure that a health facility can withstand and remain operational in emergencies.

*Barkemeyer, B. (2006). [Practicing Neonatology in a Blackout: The University Hospital NICU in the Midst of Hurricane Katrina: Caring for Children Without Power or Water.](#) Pediatrics. 117(Suppl. 4):S369 -S374.

The author recounts the challenges associated with providing care in a university hospital's neonatal intensive care unit before, during, and after Hurricane Katrina made landfall.

New Mexico Department of Homeland Security and Emergency Management. (2013). [New Mexico State Hazard Mitigation Plan.](#)

This plan describes how to identify, assess, and mitigate natural hazards in New Mexico. It also addresses mitigation planning requirements for federal hazard mitigation grant funding.

Novation. (n.d.) [Emergency Disaster Plan Template.](#) (Accessed 10/20/2015.)

Healthcare facility emergency planners can use this template when developing their emergency operations plan. It features 12 disaster scenarios, including: hurricane, tornadoes, structure fires, earthquakes, and extreme cold.

U.S. Department of Health and Human Services (HHS). (2014). [Primary Protection: Enhancing Health Care Resilience for a Changing Climate.](#)

This 86-page document is a guide and toolkit designed to assist healthcare providers, design professionals, policymakers, and others with roles and responsibilities in assuring the continuity of quality health and human care before, during, and after extreme weather events. It is focused on healthcare infrastructure resilience to climate change impacts as manifested primarily by extreme weather events.

*U.S. Department of Health and Human Services. (2015). [GeoHealth Platform.](#)

This tool provides central access to federal disaster and public health related natural disaster alerts, warnings, and other resources.

U.S. Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response. (2013). [Planning for Power Outages: A Guide for Hospitals and Healthcare Facilities.](#)

This document highlights issues for healthcare facilities to consider regarding power outages. It also provides a checklist of key planning considerations, and recommendations for fostering a relationship with a facility's utility company.

U.S. Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response. (2013). [Planning for Water Supply Interruptions: A Guide for Hospitals & Healthcare Facilities.](#)

This document provides information on the impact of water loss on healthcare facilities, and a series of questions for planners to use to prepare their facilities for water service interruptions.

U.S. Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response. (2014). [Working Without Technology: How Hospitals and Healthcare Organizations Can Manage Communication Failure.](#)

This fact sheet summarizes steps a healthcare facility can take to ensure communication during incident response when normal technologies fail.

Lessons Learned

Earthquakes

Ardagh, M.W., Richardson, S.K., Robinson, V., et al. (2012). [The Initial Health-System Response to The Earthquake in Christchurch, New Zealand, in February, 2011.](#) Lancet. 379(9831):2109-15.

The authors describe their experiences and lessons learned working in the emergency department of the only regional acute care hospital following the 2011 New Zealand earthquake. They note that emergency department response plans should account for patients arriving in atypical ways; loss of power; the need for paper registration and tracking systems; volunteer management; and teamwork with clear leadership, among other things.

Burnweit, C. and Stylianos, S. (2011). [Disaster Response in a Pediatric Field Hospital: Lessons Learned in Haiti.](#) (Abstract only.) Journal of Pediatric Surgery. 46(6):1131-9.

The authors describe their experiences in a pediatric field hospital in Haiti following the 2010 earthquake. They discuss requirements for equipment, manpower, medical records, and systems addressing volunteer stress, as well as ethical issues. They also note that 93% of casualties initially were surgical admissions with 40% undergoing operations in the first week after the event, mostly for fractures and wound care.

Fuse, A. and Yokota, H. (2012). [Lessons Learned From the Japan Earthquake and Tsunami, 2011.](#) Journal of Nippon Medical School. 79(4):312-5.

The authors discuss lessons learned from the 2011 Japanese earthquake and tsunami, and present a graphic entitled the "chain of survival for disasters" to help guide decision-makers and emergency response planners during natural disasters.

*Geiger, A., Kawauchi, K. and Bellamy, S. (2015). [Innovative Disaster Responses Model Approaches from Japan's 3/11 Disaster.](#) Japan Center for International Exchange.

The authors present four examples of initiatives that helped communities recover from Japan's earthquake/tsunami "3/11 Disaster." They stress the important role of healthcare providers in ensuring access to care and reducing stressors in survivors.

Kang, P., Zhang, L., Liang, W., et al. (2012). [Medical Evacuation Management and Clinical Characteristics of 3,255 Inpatients after the 2010 Yushu Earthquake in China.](#) (Abstract only.) *Journal of Trauma and Acute Care Surgery*. 72(6): 1626-1633.

The authors conducted a medical analysis of injuries and diseases after an earthquake that struck a remote, high-altitude region. They listed related challenges and suggestions for future healthcare provider training topics.

Kirsch, T., Mitrani-Reiser, J., Bissell, R., et al. (2010). [Impact on Hospital Functions Following the 2010 Chilean Earthquake.](#) *Disaster Medicine and Public Health Preparedness*. (Abstract only.) 4(2); 122-128.

The authors describe loss of functions and structural damage experienced by hospitals in Chile following a major earthquake. Loss of communications capability was cited by hospital administrators surveyed as being most problematic.

*Li, X.H., Hou S.K., Zheng J.C., et al. (2012). [Post-Disaster Medical Rescue Strategy in Tropical Regions.](#) *World Journal of Emergency Medicine*. 3(1): 23–28.

The authors analyzed the medical response to earthquakes and tsunamis in tropical regions and found that shock, infection, and heat stroke were frequently encountered by survivors.

Lorich, D.G., Jeffcoat, D.M., MacIntyre, N.R., et al. (2010). [The 2010 Haiti Earthquake: Lessons Learned?](#) (First page only.) *Techniques in Hand and Upper Extremity Surgery*. 14(2):64-8.

The authors discuss how the assumptions and planning for their orthopedic surgery team deployed to assist after the 2010 Haiti earthquake were "naïve," and they present their lessons learned.

*Miller, A. and Arquilla, B. (2008). [Chronic Diseases and Natural Hazards: Impact of Disasters on Diabetic, Renal, and Cardiac Patients.](#) (Abstract only.) *Prehospital and Disaster Medicine*. 23(2):185-94.

The authors reviewed data on the disease burden for exacerbation of chronic diseases following natural disasters, focusing on renal, cardiac, and diabetic patients. They note that it is critical for healthcare providers to anticipate the need for care in this population and to educate patients on their diseases so that they can better manage their conditions following a disaster.

*Nagamatsu, S., Maekawa, T., Ujike Y., et al. (2011). [The Earthquake and Tsunami-- Observations by Japanese Physicians Since the 11 March Catastrophe](#). Critical Care. 15(3):167.

The authors discuss how lessons learned from the 1995 Hanshin earthquake and effective use of the Internet for communication and coordination assisted with the response to the 2011 earthquake and tsunami. They also describe and compare the injuries and causes of death for the two events.

Peleg, K. and Kellerman, A. (2012). [Medical Relief After Earthquakes: It's Time for a New Paradigm](#). (First page only.) Annals of Emergency Medicine. 59:188-190.

The authors discuss lessons learned from recent earthquakes worldwide and explore how resources spent on search and rescue missions may diminish resources available for other needs, including healthcare.

Rajpura, A., Boutros, I., Khan, T., Khan, S.A. (2010). [Pakistan Earthquake: Experiences of a Multidisciplinary Surgical Team](#). (Abstract only.) Pre-hospital and Disaster Medicine. 25(4):361-7.

The authors describe the injuries encountered in the weeks following the Pakistan earthquake in 2005, and the joint efforts by orthopedic and plastic surgeons that were required to treat them.

Sanford, C. (2010). [Post-Earthquake Medicine in Haiti: Disaster Relief at a Field Hospital](#). (Free registration required.) University of Washington, Northwest Center for Public Health Practice.

In this one-hour Hot Topics webinar, Dr. Sanford shares his experiences and reflects upon lessons learned that may have important implications for public health planning and response to major disasters.

Schultz, C. (2014). [The Hospital Response after an Earthquake](#).

The speaker presents an in-depth overview of the hospital response to earthquakes that struck California in 1971 and 1994. He divided his findings by functional and non-functional hospitals, and presented information on communication challenges, staff behavior (e.g., decisions to report to work), and potential sources of assistance should a similar earthquake strike the Jerusalem area of Israel.

*Yonekura, T., Ueno, S., and Iwanaka, T. (2013). [Care of Children in a Natural Disaster: Lessons Learned from the Great East Japan Earthquake and Tsunami](#). (Abstract only.) Pediatric Surgery International. 29(10): 1047-1051.

The authors incorporate lessons learned from the Fukushima disaster into response recommendations for pediatric surgeons and physicians.

Zhang, B., Liu, Z., Lin, Z., et al. (2012). [Microbiologic Characteristics of Pathogenic Bacteria From Hospitalized Trauma Patients Who Survived Wenchuan Earthquake](#). (Abstract only.) European Journal of Clinical Microbiology & Infectious Diseases. 31 (10): 2529-2535.

The authors characterize the bacteria isolated from trauma patients following the 2008 Wenchuan earthquake, and associated antibiotic susceptibilities. They found that the distribution spectrum of pathogens isolated from trauma patients after the earthquake was different from that for non-earthquake trauma patients in the same hospital at the same time.

Excessive Heat

Altman, P., Lashof, D., Knowlton, K., et al. (2012). [Killer Summer Heat: Projected Death Toll from Rising Temperatures in America Due to Climate Change](#). Natural Resources Defense Council.

The authors of this report analyze the results of independent peer-reviewed scientific papers and present the findings of increasing heat-related mortality due to global warming for the 40 largest U.S. cities. Their findings indicate that rising temperatures, driven by persistent climate change, will increase the number of life-threatening excessive heat events.

Anderson, B. and Bell, M. (2009). [Weather-Related Mortality: How Heat, Cold, and Heat Waves Affect Mortality in the United States](#). Epidemiology. 20(2): 205–213.

The authors applied time-series models to a 14-year dataset featuring 107 U.S. communities to relate cold, heat, and heat wave effect estimates to community-specific variables (e.g., socioeconomic factors and urbanicity).

* Lavigne, E., Gasparrini, A., Wang, X., et al. (2014). [Extreme Ambient Temperatures and Cardiorespiratory Emergency Room Visits: Assessing Risk by Comorbid Health Conditions in a Time Series Study](#). Environmental Health. 13:5.

The authors looked at 292,666 cardiovascular and 562,738 respiratory disease Emergency Department (ED) visits over an eight-year period in Toronto. They found that: diabetics exposed to extreme heat had more ED visits vs. non-diabetics; respiratory disease ED visits during hot weather were higher for individuals with comorbid respiratory diseases and cancer; exposure to extreme cold temperatures over a 2-week period increased cardiovascular disease ED visits for individuals with comorbid cardiovascular diseases, and kidney diseases.

The Lancet. (2015). [Health Professionals: Be Prepared for Heatwaves](#). 386(9990): 219.

This editorial provides an overview of factors and issues to consider during heatwaves. The article includes links to the report authored by the World Health Organization and

World Meteorological Organization, guidance from the Centers for Disease Control and Prevention, and other applicable webpages.

U.S. Environmental Protection Agency, Office of Atmospheric Programs. (2006). [Excessive Heat Events Guidebook](#).

This guidebook identifies best practices that have been implemented to save lives during excessive heat events in various urban areas. It provides critical information needed to help local public health officials, emergency managers, meteorologists, and others assess their community's vulnerability to excessive heat waves, and develop and implement notification and response programs.

Extreme Cold

Burstein, G., Blank, J., Fricano Chalmers, T., et al. (2015). [Notes from the Field: Snowstorm-Related Mortality — Erie County, New York, November 2014](#). Morbidity and Mortality Weekly Report (MMWR). 64(33):920-921.

The authors describe a recent snowstorm that exceeded weather forecasts and contributed to 11 deaths in Southern Erie County (NY). Most of these deaths were "potentially preventable," and the Centers for Disease Control and Prevention developed a winter weather checklist to emphasize the importance of preparing for similar weather events.

Giang, P.N., Dung do V., Bao Giang, K., et al. (2014). [The Effect of Temperature on Cardiovascular Disease Hospital Admissions Among Elderly People in Thai Nguyen Province, Vietnam](#). Global Health Action. 7:23649.

Cardiovascular disease (CVD) admissions from four hospitals over 5 years were merged with weather data to determine if temperature affected hospital admissions among elderly people with CVD. The authors found that CVD admissions increased in the elderly during a period of 4-15 days following exposure to extreme cold, peaking at around a week's time after exposure.

Hughes, H.E., Morbey, R., Hughes, T.C., et al. (2014). [Using an Emergency Department Syndromic Surveillance System to Investigate the Impact of Extreme Cold Weather Events](#). (Abstract only.) Public Health. 128(7):628-35.

The authors looked at syndromic surveillance data from England for the 2010-11 and 2011-12 winters to characterize cold weather-related Emergency Department visits. The authors found that the strongest fit with temperature was cold-related fractures in females, and strongest fit for snowfall was cold-related fractures in both sexes.

*Lavigne, E., Gasparini, A., Wang, X., et al. (2014). [Extreme Ambient Temperatures and Cardiorespiratory Emergency Room Visits: Assessing Risk by Comorbid Health Conditions in a Time Series Study](#). Environmental Health. 13:5.

The authors looked at 292,666 cardiovascular and 562,738 respiratory disease Emergency Department (ED) visits over an eight-year period in Toronto. They found that: diabetics exposed to extreme heat had more ED visits vs. non-diabetics; respiratory disease ED visits during hot weather were higher for individuals with comorbid respiratory diseases and cancer; exposure to extreme cold temperatures over a 2-week period increased cardiovascular disease ED visits for individuals with comorbid cardiovascular diseases, and kidney diseases.

Meiman, J., Anderson, H., and Tomasallo, C. (2015). [Hypothermia-Related Deaths — Wisconsin, 2014, and United States, 2003–2013](#). Morbidity and Mortality Weekly Report. 64(06);141-143.

This MMWR describes three selected cases of hypothermia-related deaths in Wisconsin, and summarizes risk factors based on all cases that occurred in the state during the period of active surveillance in 2014. A summary of hypothermia-related deaths for the United States during 2003–2013 also is presented for comparison.

Qiu, H., Tian, L., Ho, K., et al. (2015). [Who is More Vulnerable to Death from Extremely Cold Temperatures? A Case-Only Approach in Hong Kong With a Temperate Climate](#). (Abstract only.) International Journal of Biometereology. 1-7.

The authors looked at 197, 680 deaths from natural causes, air temperature, and air pollution rates from November to April for 9 consecutive years. They found that individuals aged 85 and older, and those with cardiovascular diseases (including hypertensive diseases, stroke, congestive heart failure, chronic obstructive pulmonary disease (COPD), and pneumonia) had the greatest risk of death from exposure to extreme cold temperatures.

Fires/Wildfire

Centers for Disease Control and Prevention. (2015). [Protect Yourself from Wildfire Smoke](#).

The information on this webpage can help first responders and community members understand the risk and protect themselves from the effects of wildfire smoke.

Finlay, S.E., Moffat, A., Gazzard, R., et al. (2012). [Health Impacts of Wildfires](#). PLOS Currents Disasters. Nov 2;4:e4f959951cce2c.

The authors conducted a comprehensive literature review of international research on wildfire-related health effects and led several focus groups with study authors. Results indicated that certain populations are especially vulnerable; wood smoke has high toxicity levels; respiratory morbidity is the leading health effect, wildfire exposure is also associated with burns (and related effects) and cardiovascular, ophthalmic, and psychiatric problems.

National Resources Defense Council. (2013). [Where There's Fire, There's Smoke: Wildfire Smoke Affects Communities Distant from Deadly Flames.](#)

Readers can learn about how smoke from wildfires—both near and far—can have an effect on health. Maps that show how smoke from wildfires in 2011 affected many areas of the U.S. are included.

Floods and Landslides

Apisarnthanarak, A., Mundy, L., Khawcharoenporn, T., et al. (2013). [Hospital Infection Prevention and Control Issues Relevant to Extensive Floods.](#) Infection Control and Hospital Epidemiology. 34(2): 200-206. (Must login to JSTOR to retrieve full article).

In this article, the authors discuss infection prevention and control experiences related to the reopening of medical facilities after recent disasters in Thailand and the U.S.

Bandino, J.P., Hang, A., and Norton, S.A. (2015). [The Infectious and Noninfectious Dermatological Consequences of Flooding: A Field Manual for the Responding Provider.](#) American Journal of Clinical Dermatology. 16(5): 399-424.

The authors provide information for clinicians caring for flood victims. They describe the conditions seen in patients following floods, and characterize the causative agents of these conditions. Treatment is also discussed.

Goldbaum, G. (2014). [Public Health's Response to the Oso Mudslide.](#) University of Washington, Northwest Center for Public Health Practice (NWCPh).

This one-hour webinar features Gary Goldbaum of the Snohomish (Washington) Health District, who discusses how his health district worked with partner agencies in response to the Oso mudslide in March 2014.

Kshirsagar, N., Shinde R., and Mehta, S. (2006). [Floods in Mumbai: Impact of Public Health Service by Hospital Staff and Medical Students.](#) Journal of Postgraduate Medicine. 52(4): 312-314.

This article discusses the impact of the Mumbai floods and the provision of shelter-based and community care for over 150,000 cases of diarrhea, many consistent with leptospirosis by hospital staff and medical students, detailing the substantially increased risk of communicable disease during flooding events with poor sanitary conditions.

*McMichael, A.J. (2015). [Extreme Weather Events and Infectious Disease Outbreaks.](#) (Abstract only.) Virulence. 6(6):539-43.

The author discusses infectious disease risks associated with extreme weather events, drawing on recent experiences, including Hurricane Katrina in 2005 and the 2010 Pakistan mega-floods. Historical examples from previous centuries of epidemics and

“pestilence” associated with extreme weather disasters and climatic changes are also discussed.

National Association of County and City Health Officials. (2015). [Coordinated Response to Flooding and the Mudslide in Washington State: An Interview with Therese Quinn.](#)

Ms. Quinn, a Medical Reserve Corps (MRC) Coordinator with Snohomish Health District, discusses the MRC response to the 2014 flooding and mudslide in Washington State.

Pereira, B., Morales W., Cardoso, R., et al. (2013). [Lessons Learned From a Landslide Catastrophe in Rio de Janeiro, Brazil.](#) (Abstract only.) American Journal of Disaster Medicine. 8(4):253-8.

The authors discuss lessons learned from this flood and landslide event in 2011, with a focus on pre-hospital and hospital organization and management of patients. They also describe the most common injuries treated (injuries were to the extremities, most requiring only wound cleaning, debridement, and suture), and note that the primary cause of death was from asphyxia due to drowning or mud burial.

Shroades, R. (2007). [Flood Preparedness: Once Bitten, Twice Ready.](#) Facility Maintenance Decisions.

This article documents how facility staff from Memorial Hermann Hospital incorporated lessons learned after Tropical Storm Allison flooded the facility with almost 40 feet of water in 2001.

Hurricanes

Arrieta, M.I., Foreman, R.D., Crook, E.D., and Icenogle, M.L. (2008). [Insuring Continuity of Care for Chronic Disease Patients After a Disaster: Key Preparedness Elements.](#) American Journal of Medical Sciences. 336(2):128-33.

The authors interviewed 30 key informants (KI), including health and social service providers that provide healthcare to the under- and uninsured along the Mississippi and Alabama Gulf Coast. Pre-disaster issues of importance were patient education and preparedness; evacuation guidance and support; planning for special medical needs shelters; and health care provider preparedness. Post-disaster issues were communication; volunteer coordination/credentialing; and donation management, particularly for medications.

Arrieta, M.I., Foreman, R.D., Crook, E.D., and Icenogle, M.L. (2009). [Providing Continuity of Care for Chronic Diseases in the Aftermath of Katrina: From Field Experience to Policy Recommendations.](#) Disaster Medicine and Public Health Preparedness. 3(3):174-82.

The authors interviewed 30 key informants, including health and social service providers that provide healthcare to the under- and uninsured along the Mississippi and Alabama Gulf Coast. Respondents indicated that mental health, diabetes mellitus, hypertension, respiratory illness, end-stage renal disease, cardiovascular disease, and cancer were medical management priorities after a disaster. The most frequently mentioned barrier to providing care was maintaining continuity of medications. Inaccessible medical records, poor patient knowledge, and financial constraints also impacted care. Implemented or suggested solutions included better pre-disaster patient education; support for electronic medical records at community health centers; and better management of donated medications/medical supplies.

*Barkemeyer, B. (2006). [Practicing Neonatology in a Blackout: The University Hospital NICU in the Midst of Hurricane Katrina: Caring for Children Without Power or Water](#). Pediatrics. 117(Suppl. 4):S369 -S374.

The author recounts the challenges associated with providing care in a university hospital's neonatal intensive care unit before, during, and after Hurricane Katrina made landfall.

Berggren, R. (2005). [Hurricane Katrina. Unexpected Necessities--Inside Charity Hospital](#). The New England Journal of Medicine. 353(15):1550-3.

The author describes her experience in Charity Hospital following Hurricane Katrina, with a focus on the unexpected necessities (e.g., shoes, extra underwear, shift work/sleep, morale-boosting activities, a team of professionals who care about patients and each other, etc.) that arose, and how they were addressed.

Brevard, S.B., Weintraub, S.L., Aiken, J.B., et al. (2008). [Analysis of Disaster Response Plans and The Aftermath of Hurricane Katrina: Lessons Learned From a Level I Trauma Center](#). (Abstract only.)The Journal of Trauma. 65(5):1126-32.

The authors retrospectively reviewed their hospital's disaster plan and compared it with actual events that occurred after Hurricane Katrina. They evaluated and scored vital support areas as adequate (3 pts), partially adequate (2 pts), or inadequate (1 pt), with the following results: water-3.0, food-2.4, sanitation-1.5, communication-1.4, and power-1.5. The authors concluded that, despite writing and exercising plans, the hospital was still not fully prepared.

Centers for Disease Control and Prevention. (n.d.). [Morbidity and Mortality Weekly Report: Hurricanes](#). (Accessed 9/25/2015.)

This website contains links to all hurricane-related MMWRs, including valuable epidemiologic information from multiple hurricanes, mold-related and other post-hurricane illnesses and injuries, and longer-term health effects.

Horahan, K., Morchel, H., Raheem, M. and Stevens, L. (2014). [Electronic Health Records Access During a Disaster](#). Online Journal of Public Health Informatics. 5(3):232.

The authors describe a novel approach to reestablishing connectivity with the electronic health records server for a hospital affected by Superstorm Sandy through resource-sharing of a disaster response asset from a hospital in a neighboring state.

*McMichael, A.J. (2015). [Extreme Weather Events and Infectious Disease Outbreaks](#). (Abstract only.) Virulence. 6(6):539-43.

The author discusses infectious disease risks associated with extreme weather events, drawing on recent experiences, including Hurricane Katrina in 2005 and the 2010 Pakistan mega-floods. Historical examples from previous centuries of epidemics and “pestilence” associated with extreme weather disasters and climatic changes are also discussed.

*Miller, A. and Arquilla, B. (2008). [Chronic Diseases and Natural Hazards: Impact of Disasters on Diabetic, Renal, and Cardiac Patients](#). (Abstract only.) Prehospital and Disaster Medicine. 23(2):185-94.

The authors reviewed data on the disease burden for exacerbation of chronic diseases following natural disasters, focusing on renal, cardiac, and diabetic patients. They note that it is critical for healthcare providers to anticipate the need for care in this population and to educate patients on their diseases so that they can better manage their conditions following a disaster.

Mitchell, L., Anderle, D., Nastally, K., et al. (2009). [Lessons Learned from Hurricane Ike](#). (Abstract only.) AORN Journal. 89(6):1073-8.

The authors describe how their hospital system's response plans were revised after Hurricane Rita in anticipation of Hurricane Ike in 2008. They note that, despite planning and exercising their plan, there were still a number of lessons learned that could be helpful to other hospitals during future disaster responses.

Office of the Inspector General. (2014). [Hospital Emergency Preparedness and Response During Superstorm Sandy](#). U.S. Department of Health and Human Services.

The authors surveyed 174 Medicare-certified hospitals located in declared disaster areas in Connecticut, New Jersey, and New York during Superstorm Sandy and conducted 10 site visits and collected other types of data. They found that a small percent of hospitals (7%) evacuated during the storm (the rest sheltered in place). The report describes several cases of flooded hospitals and recommends continued community disaster collaboration.

Okie, S. (2008). [Dr. Pou and the Hurricane — Implications for Patient Care during Disasters](#). The New England Journal of Medicine. 358(1):1-5.

The author discusses the circumstances surrounding the arrest of a physician and two nurses for allegedly euthanizing four elderly patients at Memorial Hospital in Louisiana after Hurricane Katrina. Issues such as altered standards of care, scarce resource allocation, triage, and indemnification and/or immunity for health professionals are included.

Ramme, A.J., Vira, S., and McLaurin, T.M. (2015). [Superstorm Sandy's Forgotten Patient: A Lesson in Emergency Preparedness in Severe Obesity](#). *Obesity*. 23(2):253-4.

The authors describe the challenges associated with evacuation of a morbidly obese patient during Superstorm Sandy, and how those challenges influenced the decision not to evacuate the patient, even in the absence of power and running water.

Redlener, I., Reilly, M. (2012). [Lessons from Sandy — Preparing Health Systems for Future Disasters](#). National Center for Disaster Preparedness, Mailman School of Public Health, Columbia University, New York.

This article discusses lessons learned from the evacuation of two NYC area hospitals in response to Hurricane Sandy in 2012.

Rosen, Y. and Yakubov, N. (2013). [Hurricane Sandy: Lessons Learned from the Severely Damaged Coney Island Hospital](#). (First page only.) *Pre-hospital and Disaster Medicine*. 28(6):643.

The authors discuss the challenges and benefits of transferring their patients to other hospitals along with their care teams in preparation for, and following Hurricane Sandy.

Schreiber, M.D., Yin, R., Omaish, M., and Broderick, J.E. (2014). [Snapshot From Superstorm Sandy: American Red Cross Mental Health Risk Surveillance in Lower New York State, Editor's Capsule Summary](#). (Abstract only.) *Annals of Emergency Medicine*. 64(1):59-65.

Red Cross disaster mental health volunteers used an evidence-based tool called PsySTART to collect data on risk factors for post-traumatic stress disorder (PTSD), depression, and anxiety among survivors at shelters, emergency aid stations, and mobile feeding and community outreach centers. They found 17,979 risk factors, with significant differences across survivors in eight counties. They also found survivors with high risk in areas apart from those with the greatest physical damage.

*Sugerman, D. and Armstrong, J. (2013). [Prevention and Treatment of Injuries Following Hurricanes and Tornadoes](#). Centers for Disease Control and Prevention.

This one-hour webinar covers the provision of pre-hospital care; the patterns of injury seen after hurricanes and tornadoes, including appropriate initial management; appropriate emergency risk communication messages; and the importance of data collection to improve messaging and response efforts.

Sullivent, E.E. 3rd, West, C.A., Noe, R.S., et al. (2006). [Nonfatal Injuries Following Hurricane Katrina--New Orleans, Louisiana, 2005](#). (Abstract only.) Journal of Safety Research. 37(2): 213-217.

Just after Hurricane Katrina, the Centers for Disease Control and Prevention collaborated with the Louisiana Department of Health and Hospitals to establish an injury and illness surveillance system in functioning hospitals and medical clinics. The surveillance system recorded more than 7,500 nonfatal injuries in the month after the storm, with the leading "mechanisms of injury" being fall and cut/stab/pierce. Residents were more likely than relief workers to be injured.

Tornadoes

Centers for Disease Control and Prevention. (2011). [Notes from the Field: Fatal Fungal Soft-Tissue Infections After a Tornado --- Joplin, Missouri, 2011](#). Morbidity and Mortality Weekly Report. 60(29);992.

This MMWR describes 13 cases (5 of which were fatal) of cutaneous mucormycosis identified after the 2011 Tornado in Joplin, Missouri. It reminds clinicians to consider fungal infections in individuals presenting with necrotizing soft-tissue infections following tornadoes, and to begin treatment as soon as possible in suspected cases.

*Chern J.J., Miller, J.H., Tubbs, R.S., et al. (2011). [Massive Pediatric Neurosurgical Injuries and Lessons Learned Following a Tornado Disaster in Alabama](#). Journal of Neurosurgery. Pediatrics. 8(6):588-92.

The authors review the clinical courses of 24 patients who suffered cranial, spinal, and peripheral nerve injuries due to the tornadoes that touched down in Alabama in 2011, and the medical responses of the pediatric neurosurgical team they were part of.

Chiu, C., Schnall, A., Mertzluft, C., et al. (2013). [Mortality from a Tornado Outbreak, Alabama, April 27, 2011](#). American Journal of Public Health. 103(8): e52-e58.

The authors examined the demographics of the 247 decedents from the tornado outbreak in Alabama on April 27, 2011 and found that females and older adults were at highest risk for tornado-related deaths. The authors stressed the importance of local community shelters (and messaging to inform residents of shelter locations); encouragement of word-of-mouth warnings; and personal and family preparedness planning (with a focus on helping vulnerable population members take shelter).

Daley, W., Brown, S., Archer, P., et al. (2005). [Risk of Tornado-Related Death and Injury in Oklahoma, May 3, 1999](#). American Journal of Epidemiology. 161(12): 1144-1150.

On May 3, 1999, powerful tornadoes, including a category F5 tornado, swept through Oklahoma, resulting in 40 deaths and hundreds of injuries. The authors examined all

tornado-related deaths, hospital admissions, and emergency department visits to identify important risk factors.

Douglas, D. and Porth, L. (2013). [Hospital Emergency Response Legal Issues: Lessons from Joplin, Missouri](#). (User must "check out" webinar at no cost.) American Health Lawyers Association.

This 90-minute webinar discusses lessons learned from the Joplin, Missouri, tornado about legal hospital emergency response issues.

Forshee-Hakala, B.A. (2015). [Pneumonia Cases Following an EF-5 Tornado](#). American Journal of Infection Control. 43(7):682-5.

The author describes pneumonia cases admitted to Freeman Health System in Joplin, Missouri from May 2009 to May 2012. She found a higher incidence of pneumonia cases, particularly those caused by uncommon microbes, in the group of cases that lived or worked in the tornado zone in the year following the Joplin tornado. She concludes that respiratory infections many increase following tornadoes, and should be treated with broad-spectrum antibiotics, not currently standard practice for community-acquired pneumonia.

Green, J. and Karras, D. (2010). [Commentary](#). Annals of Emergency Medicine. 59(1):54-55.

The authors write that disaster-related wounds contaminated with soil or vegetative matter should be monitored for mucormycosis. They provide an overview of treatment strategies and encourage emergency physicians to “maintain a high index of suspicion for cutaneous mucormycosis infections when deep injuries” present.

Neblett Fanfair, R., Benedict, K., Bos, J., et al. (2012). [Necrotizing Cutaneous Mucormycosis after a Tornado in Joplin, Missouri, in 2011](#). The New England Journal of Medicine. 367:2214-2225.

The authors review data on 13 patients who developed necrotizing cutaneous mucormycosis, a rare fungal infection, in addition to other injuries sustained from an F-5 tornado. The authors share risk factors, treatment strategies, and other relevant information that can help healthcare providers work with tornado survivors.

Niederkrötenhaler, T., Parker, E.M., Ovalle, F. et al. (2013). [Injuries and Post-Traumatic Stress Following Historic Tornadoes: Alabama, April 2011](#). PLoS One. 8(12): e83038.

The authors analyzed tornado-related injuries seen at hospitals and risk factors for tornado injury, and screened for post-traumatic stress following a statewide tornado-emergency in Alabama in April 2011. The majority of injuries were not life-threatening; the most severe injuries affected the head and chest regions.

Porth, L. (2012). [Preparedness and Partnerships: Lessons Learned from the Missouri Disasters of 2011 \(A Focus on Joplin\)](#). Missouri Hospital Association.

This report describes response and recovery operations by several hospitals during the 2011 natural disasters in Missouri. It summarizes lessons learned, with a focus on the Joplin tornado.

*Reynolds, M. (n.d.). [The Joplin Tornado: The Hospital Story and Lessons Learned](#). (Accessed 10/20/2015.) Leading Age Missouri.

The presenter focuses on four main areas: the impact of an unexpected natural disaster on healthcare services; how the nation responded to help the Joplin community; how to incorporate lessons learned into planning; and how to design enhancements that can protect against future incidents.

Shin, P. and Jacobs, F. (2012). [An HIT Solution for Clinical Care and Disaster Planning: How One Health Center in Joplin, MO Survived a Tornado and Avoided a Health Information Disaster](#). Online Journal of Public Health Informatics. 4(1).

This article describes the planning one health center undertook to secure its data so that it could be accessed after a disaster, and discusses why healthcare information technology must be a priority focus for planning. The authors advocate for increased federal funding and clear guidelines from federal planning partners in support of physical security, data back-up, and redundancy planning, as well as staff training to support these technology needs.

*Sugerman, D. and Armstrong, J. (2013). [Prevention and Treatment of Injuries Following Hurricanes and Tornadoes](#). Centers for Disease Control and Prevention.

This one-hour webinar covers the provision of pre-hospital care; the patterns of injury seen after hurricanes and tornadoes, including appropriate initial management; appropriate emergency risk communication messages; and the importance of data collection to improve messaging and response efforts.

Tsunamis

Carballo, M., Daita, S. and Hernandez, M. (2005). [Impact of the Tsunami on Healthcare Systems](#). Journal of the Royal Society of Medicine. 98(9):390-395.

The authors describe the effects of the 2004 tsunami on medical facilities and systems in 10 countries.

Centers for Disease Control and Prevention. (2005). [Rapid Health Response, Assessment, and Surveillance After a Tsunami -- Thailand, 2004-2005](#). Morbidity and Mortality Weekly. 54(3):61-64.

This article describes the health response to the 2004 tsunami that caused nearly 225,000 deaths in eight countries on two continents. Information on rapid response, conducting health and needs assessments, and public health surveillance is included.

Centers for Disease Control and Prevention. (2013). [Tsunami-Related Information for Clinicians](#).

This webpage includes general information on the health effects of tsunamis, resources on handling human remains, and links to disaster mental health resources.

*Geiger, A., Kawauchi, K. and Bellamy, S. (2015). [Innovative Disaster Responses Model Approaches from Japan's 3/11 Disaster](#). Japan Center for International Exchange.

The authors present four examples of initiatives that helped communities recover from Japan's earthquake/tsunami "3/11 Disaster." They stress the important role of healthcare providers in ensuring access to care and reducing stressors in survivors.

*Li, X.H., Hou S.K., Zheng J.C. et al. (2012). [Post-Disaster Medical Rescue Strategy in Tropical Regions](#). World Journal of Emergency Medicine. 3(1): 23–28.

The authors analyzed the medical response to earthquakes and tsunamis in tropical regions and found that shock, infection, and heat stroke were frequently encountered by survivors.

*Nagamatsu, S., Maekawa, T., Ujike Y., et al. (2011). [The Earthquake and Tsunami--Observations by Japanese Physicians Since the 11 March Catastrophe](#). Critical Care. 15(3):167.

The authors discuss how lessons learned from the 1995 Hanshin earthquake and effective use of the Internet for communication and coordination assisted with the response to the 2011 earthquake and tsunami. They also describe and compare the injuries and causes of death for the two events.

*Yonekura, T., Ueno, S., and Iwanaka, T. (2013). [Care of Children in a Natural Disaster: Lessons Learned from the Great East Japan Earthquake and Tsunami](#). (Abstract only.) Pediatric Surgery International. 29(10): 1047-1051.

The authors incorporate lessons learned from the Fukushima disaster into response recommendations for pediatric surgeons and physicians.

Mitigation

American Meteorological Society. (2014). [A Prescription for the 21st Century: Improving Resilience to High-Impact Weather for Healthcare Facilities and Services](#).

This report shares workshop findings on increasing and improving the resilience of healthcare facilities and services to high-impact weather events. The workshop grouped

their findings into three main categories: hardening structures, making incremental adaptations, and implementing innovative practices.

Arnold, C., Holmes, W., Quinn, R., et al. (2007). [Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds](#). Federal Emergency Management Agency.

This design guide can inform and help design professionals, hospital administrators, and facility managers employ sound mitigation measures that will decrease the vulnerability of hospitals to disruptions from natural hazard events (e.g., earthquakes, high wind events, floods).

*Banatin, C. and Go, M. (2010). [Safe Hospitals in Emergencies and Disasters: Structural, Non-Structural and Functional Indicators](#). World Health Organization, Regional Office for the Western Pacific.

This vulnerability assessment highlights structural, non-structural, and functional elements that must be considered to ensure that a health facility can withstand and remain operational in emergencies.

Federal Emergency Management Agency. (2013). [Earthquake Mitigation for Hospitals](#).

The materials from this workshop can help hospital administrators and facility managers identify opportunities to implement seismic mitigation in their facilities.

Iddona, C., Mills, T., Giridharand, R., and Lomas, K. (2015). [The Influence of Hospital Ward Design on Resilience to Heat Waves: An Exploration Using Distributed Lag Models](#). Energy and Buildings. 86: 573-588.

The authors use models to measure the resilience of different medical building types to excessive heat. They found that masonry and Nightingale wards (a large room without subdivisions) fared better than rooms in light-weight modular buildings.

Krauskopf, R.; Saavedra, R. (2004). [Guidelines for Vulnerability Reduction in the Design of New Health Facilities](#). World Health Organization, Pan American Health Organization (PAHO).

This 106-page document provides information about three potential levels of protection for hospitals and health facilities from adverse events such as disasters, or performance objectives: life safety, investment protection, and functional protection.

*Low, D., Mahadevia, A., Perotin, M., et al. (2013). [Flood Proofing Non-Residential Buildings](#). Federal Emergency Management Agency.

This guidance document includes two hospital-specific case studies that illustrate the successful use of floodwalls.

*Reynolds, M. (n.d.). [The Joplin Tornado: The Hospital Story and Lessons Learned](#). (Accessed 10/20/2015.) Leading Age Missouri.

The presenter focuses on four main areas: the impact of an unexpected natural disaster on healthcare services; how the nation responded to help the Joplin community; how to incorporate lessons learned into planning; and how to design enhancements that can protect against future incidents.

World Health Organization. (2009). [Save Lives: Make Hospitals Safe in Emergencies](#).

This document discusses how to safeguard health facilities from natural disasters, how to retrofit existing facilities, and plan and train for emergencies.

Plans, Tools, and Templates

Earthquakes

Children's Hospital and Research Center Oakland. (n.d.) [Children's Hospital Earthquake Response Guide](#). (Accessed 10/20/2015.)

The goal of this plan is to maintain hospital operations for at least four days after a major earthquake and to ensure that care continues for patients, visitors, and survivors of the earthquake. This plan can be adapted to meet the needs of hospital emergency response professionals and healthcare preparedness planners.

Muhlenberg Community Hospital. (2015). [Hospital Wide Earthquake Plan](#).

This webpage provides a summary of the hospital's earthquake plan and can help assist other hospitals as they update or develop their own earthquake plan.

Excessive Cold

Weston, B., Lappe, M., and Hick, J. (2014). [Blizzard Checklist](#). Hennepin County Medical Center.

This checklist can help healthcare facility staff plan for and respond to major snowstorms (i.e., 12 or more inches of accumulation).

Centers for Disease Control and Prevention, Emergency Preparedness and Response. (2014). [Winter Weather Checklists](#).

These checklists can help residents prepare for winter weather. Checklists for communication, heating, food and safety, and car supplies are included.

Oregon Health Authority, Public Health Division Health Security, Preparedness, and Response Program. (2015). [Risk Communication Toolkit for Winter Weather](#).

This toolkit can help local health authorities develop public messaging before and during periods of extreme cold weather. It includes key messages, sample press releases, factsheets, links to key resources, and sample social media messages for Twitter and Facebook.

St. Joseph's (MN) Medical Center. (2011). [Snow Emergency Plan](#).

This document outlines the hospital's plan for “an anticipated or an actual snow storm, the severity or duration, or any combination in which it is necessary.” It includes information on personnel practices, nurse staffing, and the transportation command center.

Excessive Heat

Arizona Department of Health Services. (2014). [Arizona Department of Health Services Heat Emergency Response Plan](#).

This plan was developed by the Arizona Department of Health Services to address and help limit the adverse public health effects from excessive heat. It identifies conditions or events that would trigger activation of the emergency response plan, and provides a framework for coordinating efforts with other agencies that provide services to at-risk populations. The plan also includes a list of prevention and educational resources that can help mitigate heat-health adverse effects and deaths.

Arizona Department of Health Services, Office of Environmental Health, Climate & Health Program. (2014). [Arizona Heat Safety Resource Guide: Resources for Local Health Officials and Public Information Officers during Extreme Heat Events](#).

This guide provides local health officials and public information officers with information on health impacts of extreme heat events, decision-support tools, and useful resources for prevention of heat-related illnesses. This document also supports the Arizona Department of Health Services Heat Emergency Response Plan.

Author Redacted. (2015). [Extreme Heat Response Plan](#).

This extreme heat response plan can be downloaded and tailored by a local jurisdiction. It was provided to ASPR TRACIE by a state representative who requested identifying information be redacted prior to sharing with the field.

Bernard, S. and McGeehin, M.A. (2004). [Municipal Heat Wave Response Plans](#). American Journal of Public Health. 94(9):1520.

The authors review heat wave plans from 18 cities and list recommendations for overcoming challenges (e.g., targeted outreach geared towards the socially isolated, begin prevention efforts before high temperatures arrive, and collect and use data to determine the effectiveness of interventions).

*Centers for Disease Control and Prevention. (2011). [Extreme Heat and Your Health: Media Toolkit](#).

The materials on this webpage include a toolkit, web tools, and press release and other templates that can help community leaders develop communication plans for extreme heat events.

Centers for Disease Control and Prevention. (2015). [Plan for Diabetes Care in Heat & Emergencies](#).

This website is geared towards people with diabetes and includes tips for planning ahead for hot weather and emergency situations.

*City of New York, Department of Health and Mental Hygiene. (2013). [Heat Wave Preparedness Checklists for Mental Health Service Providers](#).

These checklists can help mental health service providers identify consumers and vulnerable residents at highest risk for heat-related illnesses.

*City of New York, Department of Health and Mental Hygiene. (2013). [Heat Wave Preparedness Checklists for Vulnerable Population Service Providers](#).

These checklists can help healthcare and other service providers identify vulnerable residents at highest risk for heat-related illnesses.

East Central (GA) Regional Hospital. [Heat Plan](#).

This document outlines the East Central Regional Hospital's plans for extreme heat situations. It includes response actions by title (e.g., Safety Manager, Nurse Director) and recovery actions. The plan also includes a list of preventive measures, symptoms and treatment, and a weather index chart that lists steps to follow by temperature level.

Health Canada. (2011). [Communicating the Health Risks of Extreme Heat Events](#).

This toolkit can help health communicators charged with developing or updating heat-health communication strategies, and features strategies for reaching specific audiences.

*Lavigne, E., Gasparrini, A., Wang, X. et al. (2014). [Extreme Ambient Temperatures and Cardiorespiratory Emergency Room Visits: Assessing Risk by Comorbid Health Conditions in a Time Series Study](#). Environmental Health. 13:5.

The authors looked at 292,666 cardiovascular and 562,738 respiratory disease Emergency Department (ED) visits over an eight-year period in Toronto. They found that: diabetics exposed to extreme heat had more ED visits vs. non-diabetics; respiratory disease ED visits during hot weather were higher for individuals with comorbid respiratory diseases

and cancer; exposure to extreme cold temperatures over a 2-week period increased cardiovascular disease ED visits for individuals with comorbid cardiovascular diseases, and kidney diseases.

Oregon Health Authority, Public Health Division Health Security, Preparedness, and Response Program. (2014). [Crisis and Emergency Risk Communication Toolkit for Extreme Heat](#).

This toolkit can help local health authorities develop public messaging before and during periods of extreme heat. It includes key messages, talking points, sample press releases, fact sheets, sample social media messages for Twitter and Facebook, and links to related information in English and Spanish.

Weston, B., Lappe, M., and Hick, J. (2014). [Heat Checklist](#). Hennepin County Medical Center.

This checklist can help healthcare facility staff plan for and respond to extreme heat events.

Fires/Wildfires

Centers for Disease Control and Prevention, Emergency Preparedness and Response. (2013). [Wildfires](#).

This webpage can help users prepare for a wildfire, take proper actions during a wildfire, and prevent injury and address physical and emotional health after a wildfire.

Jagnarine, S., Van Alphen, D., Gibbs, T., et al. (2014). [Hospitals Don't Burn!: Hospital Fire Prevention and Evacuation Guide](#). World Health Organization, Pan American Health Organization (PAHO).

This 46-page document was created to address the vulnerability of hospitals to fires. It is intended that all possible steps should be taken to minimize the hazard of fires in hospitals and the need for evacuation. The guide is applicable to existing hospitals that can be retrofitted to improve safety against fires, as well as proposed new-build facilities.

* National Wildfire Coordinating Group. (2015). [InciWeb](#).

This webpage provides up-to-date information on wildfires across the country. Users can search by state or incident name. Photographs, announcements, and news articles are also included.

Oregon Health Authority, Public Health Division Health Security, Preparedness, and Response Program. (n.d.) [Wildfire and Smoke](#). (Accessed 9/15/2015.)

This webpage includes information and links to factsheets and other resources that can help users learn about current wildfires, smoke conditions, and how to reduce the health effects of wildfire smoke.

Oregon Health Authority, Public Health Division Health Security, Preparedness, and Response Program. (2015). [Crisis and Emergency Risk Communication Toolkit for Wildfire Smoke](#).

This toolkit can help local health authorities develop public messaging during a severe wildfire smoke event. It includes key messages, talking points, sample press releases, sample social media messages for Twitter and Facebook, and links to related information.

U.S. Department of Health and Human Services, Disaster Information Management Research Center. (2015). [Fires and Wildfires](#).

This webpage provides links to fire and health-related information and other relevant resources. Information is geared towards health professionals and the general public.

Weston, B., Lappe, M., and Hick, J. (2014). [Heat Checklist](#). Hennepin County Medical Center.

This checklist can help healthcare facility staff plan for and respond to extreme heat events.

Floods and Landslides

Louisiana State University Health Sciences Center. (2012). [External Flood Prevention Plan](#). Campus Wide/Hospital Safety Manual.

This plan was designed to help prevent floodwaters from entering the ground floor of the medical school and hospital and can be used by medical facility planners faced with similar challenges.

*Low, D., Mahadevia, A., Perotin, M., et al. (2013). [Flood Proofing Non-Residential Buildings](#). Federal Emergency Management Agency.

This guidance document includes two hospital-specific case studies that illustrate the successful use of floodwalls.

Oregon Health Authority, Public Health Division Health Security, Preparedness, and Response Program. (2015). [Risk Communication Toolkit for Flooding](#).

This toolkit can help local health authorities develop public messaging before, during, and after a flood event. It includes information relevant to the actual event and the recovery period: key messages, talking points, sample press releases, factsheets, links to key resources, and sample social media messages for Twitter and Facebook.

World Health Organization, Regional Office for Europe. (2014). [Floods and Health: Fact Sheets for Health Professionals](#).

These fact sheets are geared towards health professionals and describe steps to take during a flood, in the absence of a flood health preparedness and response plan. The sheets cover a variety of strategies including: vaccination during flood events, food safety, water and hygiene in healthcare facilities during and after flood events, and post-flood disinfection strategies.

Hurricanes

Jackson Health System. (2012). [Hurricane Response Plan](#).

This healthcare facility hurricane plan can serve as a model for others. It includes sections on scope and planning assumptions, hazard analysis (which can be tailored to a specific jurisdiction), concept of operations (from preparation to recovery), accommodations, employee plans, information on making claims for reimbursement for disaster-related damage, and hospital incident command system.

Monroe Regional Medical Center. (2012). [Hurricane Preparedness Plan](#).

This plan includes sections on pre-hurricane planning, procedures to follow during a hurricane, and recovery. It also includes appendices on a variety of topics, including a list of shelters in the area, items to bring if working during and after a storm, and visitor policy.

National Institute of Environmental Health Sciences. (n.d.) [Hurricane Worker Podcasts](#). (Accessed 9/15/2015.) National Clearinghouse for Worker Safety and Health Training.

These short podcasts were developed to help emergency responders and recovery workers prepare for hurricane-related hazards (e.g., mold, debris, and electrical hazards).

New Jersey Hospital Association. (2010). [Weathering the Storm: A Hurricane Planning, Response, and Recovery Toolkit](#).

This plan was written to help state hospitals prepare for, respond to, and recover from hurricanes. The plan focuses on sheltering in place and related needs. The plan also includes templates that can be tailored by healthcare facilities.

Tornadoes

Muhlenberg Community Hospital. (2015). [Tornado Warning Plan](#).

This webpage lists the steps that will be taken by the hospital in the event of a tornado warning. Steps are listed by the person responsible for taking them.

Tsunamis

Intergovernmental Oceanographic Commission (IOC) of UNESCO. (2008). [Tsunami Preparedness: Information Guide for Disaster Planners.](#)

This document provides a general plan of action and basic framework for dealing with the unique hazards resulting from tsunamis and can be adapted for use by healthcare emergency planners.

Agencies and Organizations

Note: The agencies and organizations listed in this section have a page, program, or specific research dedicated to this topic area.

Centers for Disease Control and Prevention. [Extreme Heat.](#)

Extension Disaster Education Network. [Heat Wave-Extreme Heat.](#)

[Federal Emergency Management Agency.](#)

[National Oceanic and Atmospheric Administration.](#)

[National Weather Service.](#)

U.S. Department of Health and Human Services, Disaster Information Management Research Center. [Fires and Wildfires.](#)

U.S. Department of Health and Human Services. [GeoHealth Platform.](#)

[United States Geologic Survey \(USGS\).](#)

*This ASPR TRACIE Topic Collection was comprehensively reviewed in August and September 2015 by the following subject matter experts (listed in alphabetical order): **Eric Alberts**, BS, FPED, CHS-V, CDP-I, CHPP, CHEP, SEM, CFRP, FABCHS, Orlando Health, Inc. (Hospital System); **Kathryn Conlon**, PhD, MPH, CDC Climate and Health Program; **Stephen Curren**, MS, Director, Division of Resilience, U.S. Department of Health and Human Services (HHS), Office of the Assistant Secretary for Preparedness and Response (ASPR), Office of Emergency Management; **L. Leon Dent**, MD, MS, MSCR, MMHC, FACS, Associate Professor of Surgery, Meharry Medical College; **John Hick**, MD, HHS ASPR and Hennepin County Medical Center; **Mark Jarrett**, MD, MBA, MS, Sr. Vice President and Chief Quality Officer, Associate Chief Medical Officer, North Shore-LIJ Health System and Professor of Medicine, Hofstra – North Shore LIJ School of Medicine; and **Paul J. Schramm**, MS, MPH, Climate and Health Program, Centers for Disease Control and Prevention.*